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Educational Television Series 1968-69

Teachers' Guide

DEPT. OF EDUCATION
HISTORICAL COLLECTION

Science

JUNIOR AND INTERMEDIATE DIVISIONS

Junior Museum

Educational Television Branch
ONTARIO DEPARTMENT OF EDUCATION
1670 Bayview Avenue, Toronto 17

SCIENCE — Junior Division

JUNIOR MUSEUM

3 programs, 20 minutes each.

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Please address inquiries and comments on this series to:

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Education Section,
ETV Branch,
1670 Bayview Avenue,
Toronto 17.

Note: The copy for the second printing of this guide has been re-organized on pages 6 and 7. Please draw this to the attention of teachers who may have received the first issue.

INTRODUCTION

The three programs in this series are designed for Grades 4 to 6, but may be of interest to Grades 7 and 8, and to advanced Primary classes as well. The programs were developed in the Junior Museum of the Centennial Centre of Science and Technology in Toronto. They are concerned with some of the principles of the physical sciences, with particular emphasis on visual perception, audio perception and energy. To further explore the principles introduced in the programs, students might duplicate the experiments and demonstrations shown.

I hear and I forget
I see and I remember
I do and I understand

Children learn by doing. They must be active participants in science to reap the most benefits. To facilitate this participation, we are presenting to both students and teachers, working models which in most cases can be recreated using materials from home or from the classroom resource corner.

It should be kept in mind that the materials listed in the activities section of each program are only suggestions and that the use of alternative materials should be encouraged. The list of investigations suggested in the post-viewing section represent only a small fraction of the experiments which will result from the programs. They are worded so that a pupil can work directly from the guide. Teachers may also wish to duplicate methods and diagrams to use on activity cards for independent class work.

PROGRAM I

VISUAL PERCEPTION

The general aim of this program is to show experiments dealing with perception and involuntary self-deception.

PROGRAM CONTENT

How do we receive information? We have developed numerous techniques for transmitting and receiving knowledge. Our five senses pass on most of the information we receive to our brain. But, can we depend upon our senses?

We will be shown, through the combined senses of two children, how we can be mistaken in what we think we are experiencing. These children will feel the effects of delayed audio feedback on their power to speak. In addition, they will try their skill at mirror-writing and will be subject to various visual illusions that will show how misleading their reactions are when they must operate in an unfamiliar or distorted frame of reference. The exhibits shown demonstrate the following problems.

Tracing a Star

The seemingly simple task of tracing a star with a pencil requires the child to look into a mirror and trace the pattern without going outside of the line. The hand is covered and cannot be seen. Difficulty arises because the information received by the brain is reversed from what is actually there.

Distorted Rooms

This illusion involves a small model of a distorted room showing two toy soldiers apparently growing and shrinking in size, and a ball rolling uphill. Another room, on a larger scale, shows children doubling in size as they walk from one side to the other.

Disorientation

Here we are shown the difficulty of walking in a bedroom which appears normal but has a floor with a 5° slant. The visitor has a tendency to orient himself in relation to the floor while, at the same time, orienting himself to the walls and furniture.

Double Reversal

An unusual mirror combination which does not reverse the image is shown. This arrangement indicates to the child how he really appears to others.

Revolving Trapezoid

A stick appears to pass through a revolving window and frame without breaking either. A revolving trapezoid provides the illusion in this exhibit. The window is a trapezoid shaped with perspective. The smaller edge of the window seems to be farther away, when actually half of the time it is closer.

Two Dimensional Illusions

Several illusions deal with lines which appear to move but do not, and with pictures which are confusing in different ways.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Some of the words used may present difficulties to pupils, depending upon their grade level. The words listed below should be defined and perhaps left on the board during the program: *illusion, perceive, parallel, code, reverse, distort, trapezoid, perspective.*

2. If students are already involved in investigations, the teacher may wish to have them note something of interest during the program for future study.

SUGGESTED POST-VIEWING ACTIVITIES

The following is only a partial list of experiments (written for the pupils) which may be carried out in the classroom as a result of the information presented in the program. Pupils working on these experiments should be encouraged to develop their own.

Mirror Reversal – True Image

Do you know how you look to your friends?

Don't say 'yes' just because you have seen yourself in a mirror. Mirrors turn you completely around. But if you take two mirrors and set them at right angles to each other, you will see yourself as others see you. Hold a book page in front of a single mirror and then in front of the two mirrors described above. What happens? **Fig. A**

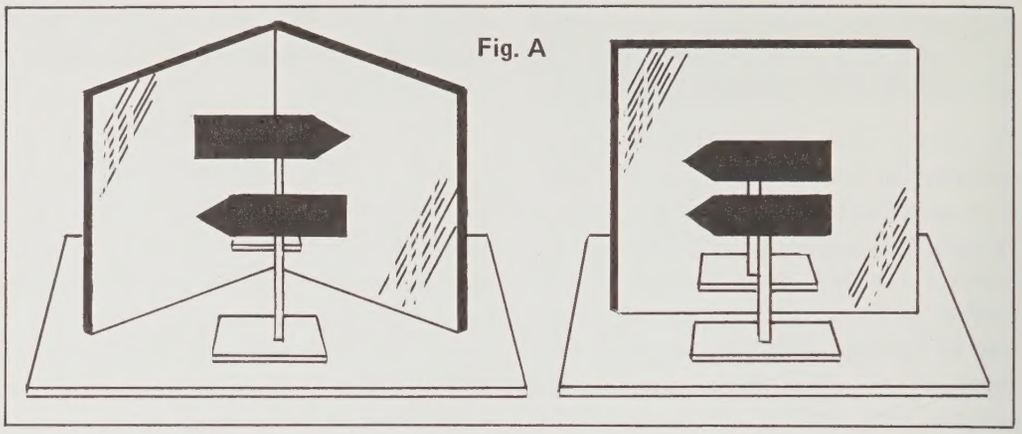

Fig. A

Star Tracing

Can you trace a star? Is this easy? You could make it challenging by standing a mirror on the desk in front of you. Lean it away from you about 5° and support it with a book. Place a piece of paper on the desk in front of the mirror with a star already drawn on it. Now, by looking only into the mirror, trace the star. Have a classmate hold another paper above the star so that you cannot see it except through the mirror. Find out who can trace the star most accurately and in the shortest time. **Fig. B**

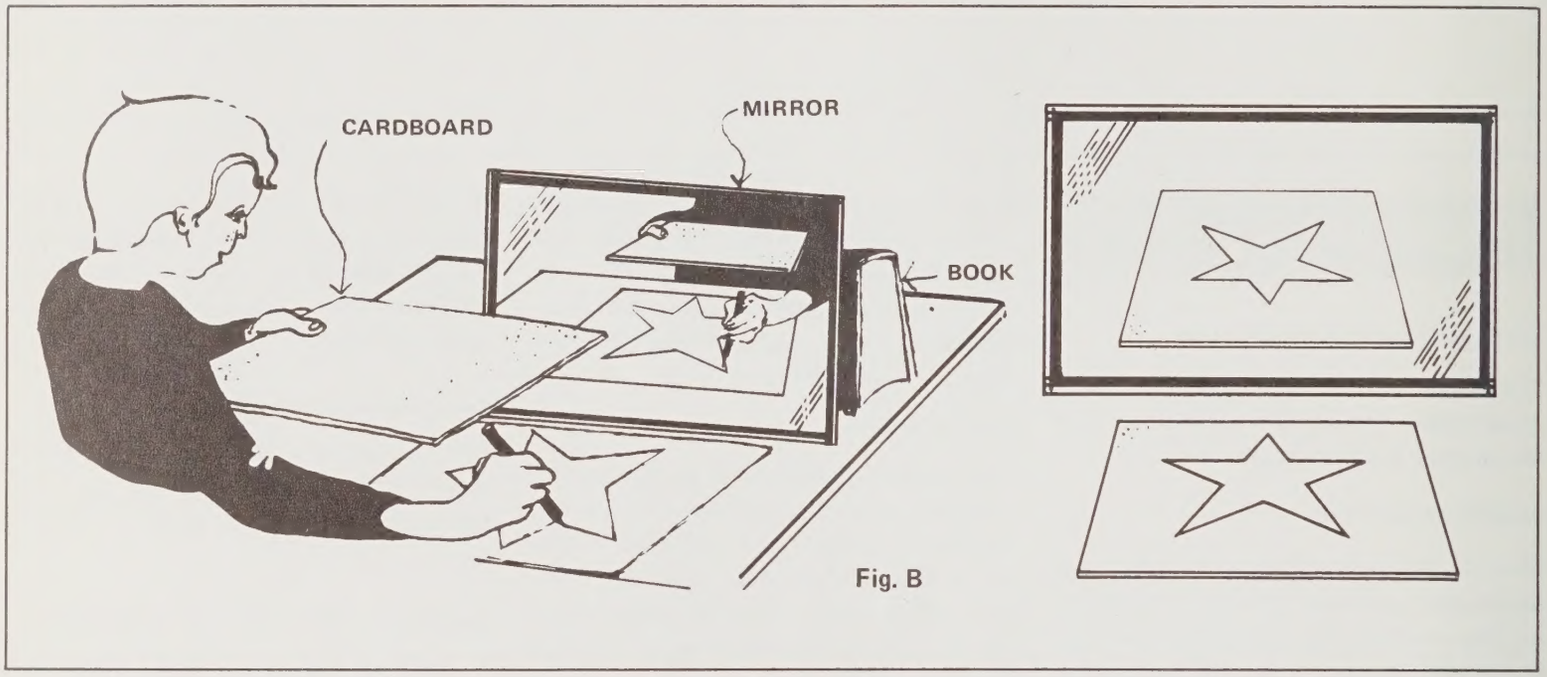

Fig. B

Reflection With Parallel Mirrors

Stand two mirrors on edge with the reflecting surfaces facing each other. Place a coin or a lighted candle between the mirrors. Look in one mirror and see how many images are formed. Can you increase this number by tilting one or both mirrors in some way? **Fig. C**

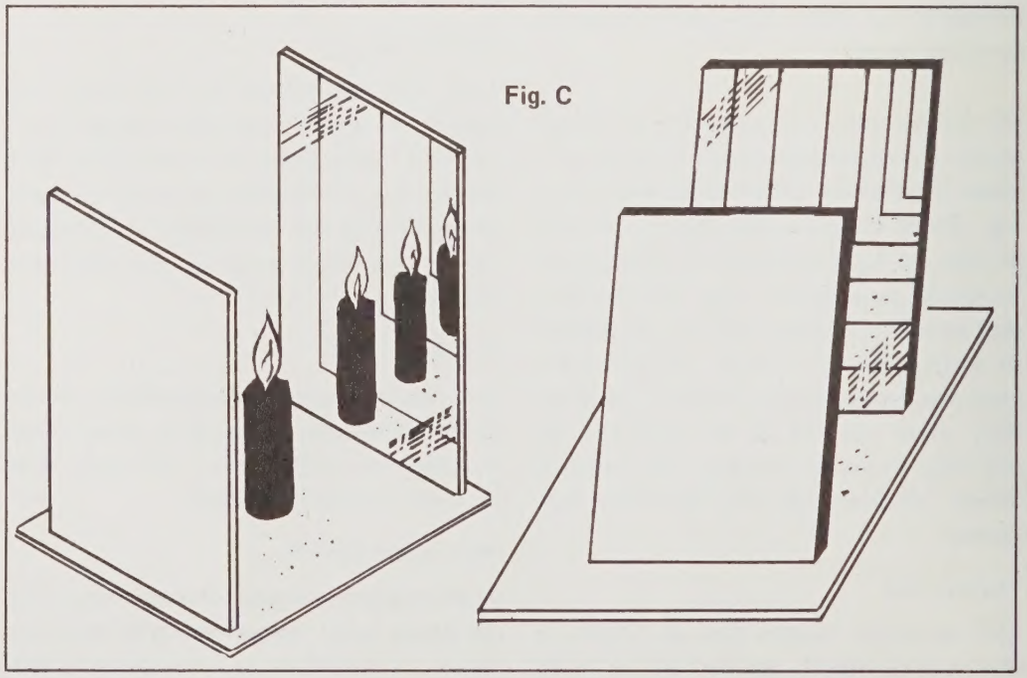

Fig. C

Images in a Kaleidoscope

Using a glass cutter, available from most hardware stores, cut two strips of mirror, approximately 2" x 6". Fasten these, together with a piece of cardboard, (also 2" x 6"), to form a long, narrow triangle. Objects viewed through this triangular prism will form a regular pattern. **Fig. D**

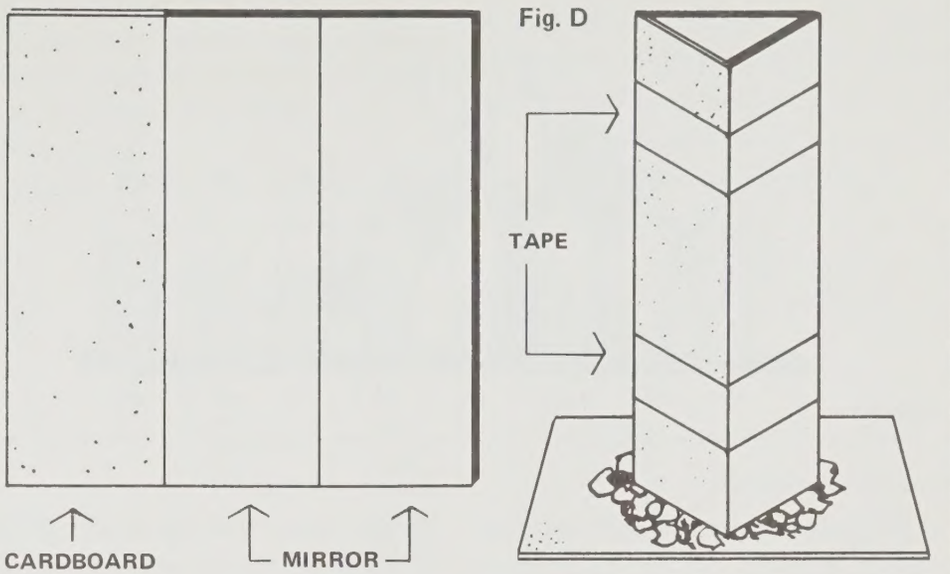

Fig. D

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PROGRAM 2

AUDIO PERCEPTION

Some exhibits illustrate the physics of sound and the various advantages derived, such as the creation of sound for enjoyment. Primitive instruments as well as some of the latest electronic and mechanical ones are shown in operation.

PROGRAM CONTENT

This program deals with the following topics and demonstrations.

Audio Delay

Can you talk and listen to yourself at the same time? What happens when what you say is heard one or two seconds later? Confusion and possibly stuttering results unless a concentrated effort is made to listen to what is being said. The student has a tendency to stop and listen.

Sound Focusing Parabolas

Two parabolas, eight feet in diameter, enable a pupil to talk in a low voice or whisper to a friend even though they are separated by a hundred feet or more in a noisy room.

Theremin

This machine produces electronic sound. Pitch and volume are controlled by waving the hand over metal plates.

Musical Instruments

Pupils will see instruments from various parts of the world in operation. Among these will be the *gamelin* from Indonesia, the *kalimba* from Africa and the instruments sculptured by Baschet in France.

SUGGESTED PRE-VIEWING ACTIVITIES

Teachers may wish to introduce some of the basic concepts dealing with sound. Discussion could be initiated with the following questions. How does sound travel? What does it look like diagramatically?

SUGGESTED POST-VIEWING ACTIVITIES

Pupils could conduct the following and other experiments.

Fig. E

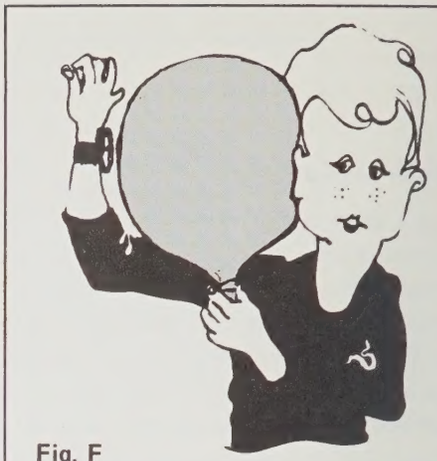

Fig. F

Adjustable Air Columns

Fill a series of pop bottles with different amounts of water. Set the air columns vibrating by blowing across the tops of the bottles. Adjust the water levels and produce a musical scale. Now, with a little practice, you can play real tunes. **Fig. E**

Sympathetic Sound

Have a friend hold the mouth of a milk bottle close to his ear without obstructing the opening. Blow strongly across the mouth of another milk bottle until you produce a strong, clear note. Your friend will hear the note coming out of his bottle. Repeat this experiment using pairs of different kinds and sizes of bottles.

Sound through a Balloon

Blow up a balloon and tie off the neck. The balloon is now partially filled with carbon dioxide gas from your lungs. Hold the balloon near your ear and a watch on the other side. Move the watch farther away until you can just barely hear it and then remove the balloon. What happens? Why? **Fig. F**

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PROGRAM 3

ENERGY

In this program pupils will see examples of the different kinds of energy encountered every day. By seeing the displays, they will gain a better understanding of the principles behind these forces.

PROGRAM CONTENT

The following topics and devices are dealt with in this program:

Bicycle Generator

By pumping a bicycle, a child can see how much electric current he can create using his own strength. The electricity produced can run a tape recorder, light electric lamps and activate a TV camera.

Van de Graaff Generator

Everyone has been given a jolt by touching a door knob or light switch at some time. This machine will show how static electricity is produced, picked up by a belt and collected in a sphere. When enough electrons are collected, they jump to the nearest conductor with a loud crack and a visible spark.

Friction

Friction is one of the most important forces in our daily living. Without it, not only would we not be able to walk, but if we did manage to get started, we would find it difficult to stop. This exhibit shows how friction affects rubber, wood, nylon and ball bearings.

Seesaw Fulcrum

This device, resembling the playground teeter-totter, enables a child to weigh himself and to balance with a friend.

Weights and Pulleys

Here the benefits of pulleys are demonstrated. The more pulleys involved, the easier the job becomes.

Water Pumps

A giant toy, made from machines which have been used through the ages to move water or change it into energy, demonstrates such things as the Archimedes Screw, an early water pumper for fire fighting, and the chain of pots still used in Egypt to raise water for irrigation.

Cartesian Diver

A force vital to all seafarers is buoyancy. The Cartesian Diver consists of a glass tube with almost neutral buoyancy. By changing the amount of water displaced in the tube, the pupil will be able to make it rise or fall.

Heat Conduction

The student touches three cylinders of wood, metal and marble. Each one seems to be a different temperature. He then learns that each one is the same temperature. Some felt colder or warmer because they were better conductors or insulators.

Magnetism

Several devices will show a revolving magnetic field, floating magnets and a floating ring.

SUGGESTED POST-VIEWING ACTIVITIES

The following experiments may be conducted by the pupils themselves.

Bicycle Generator

Bring a bicycle with a light generator on it into the classroom. Invert the bicycle and find out how many different types of

machines can be operated using the electricity created by the generator. The generator will only have one wire on it, so a second wire (grounding wire) will have to be connected to the metal casing or bracket. A six volt direct current will be produced.

Friction

Set up experiments to show friction and how it can be alleviated using various liquids and solids; for example, different types of shoes on a waxed floor.

Weights and Pulleys

Using wooden spools, (like the kind with thread on them), experiment with a fairly heavy weight to determine the correct combination of spools to lift the weight with the least amount of effort. Spring-type scales may be used to measure the pull required to lift the weight. **Fig. G**

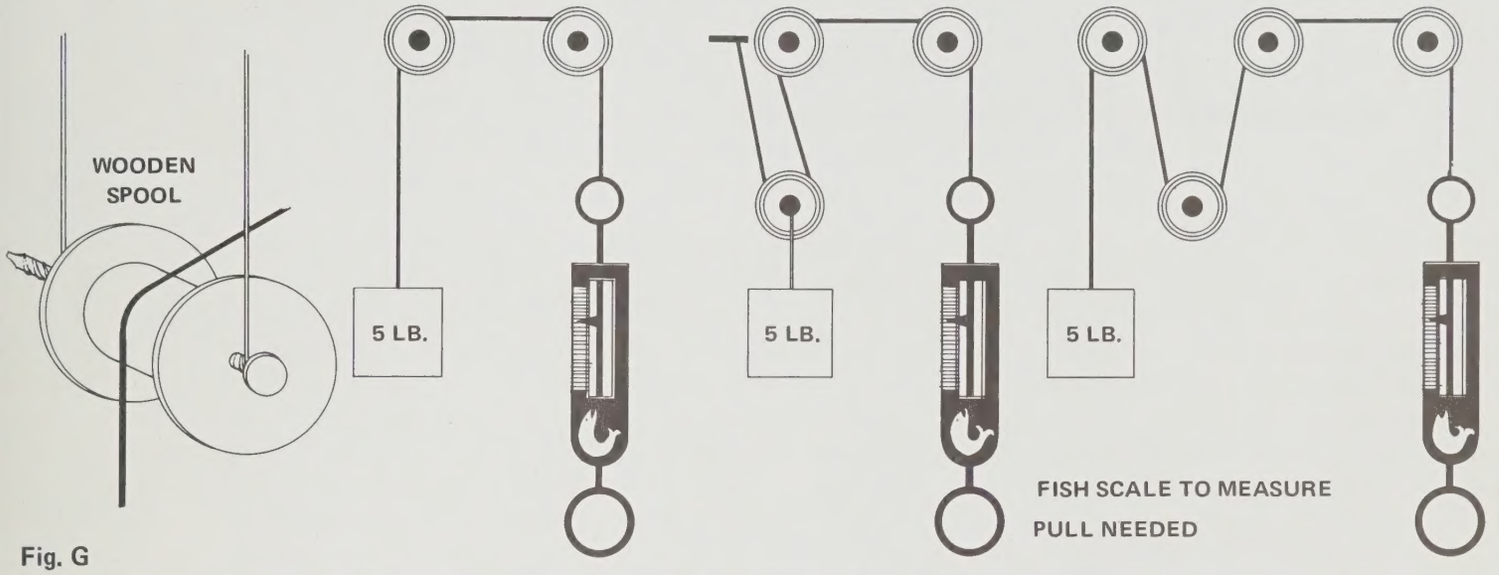

Fig. G

Cartesian Diver

Several different types of 'divers' may be used in this investigation. Among these are wooden match heads, eye droppers and test tubes. Fill a large bottle to the brim with water. Place the diver in the water and, where possible, adjust the water in the diver so that it barely floats. Stretch a piece of rubber inner tube over the top of the bottle and fasten it securely with wire, string, or rubber bands. Now, push down on the rubber top. What happens? Can you make the diver stop and remain in the middle? **Fig. H**

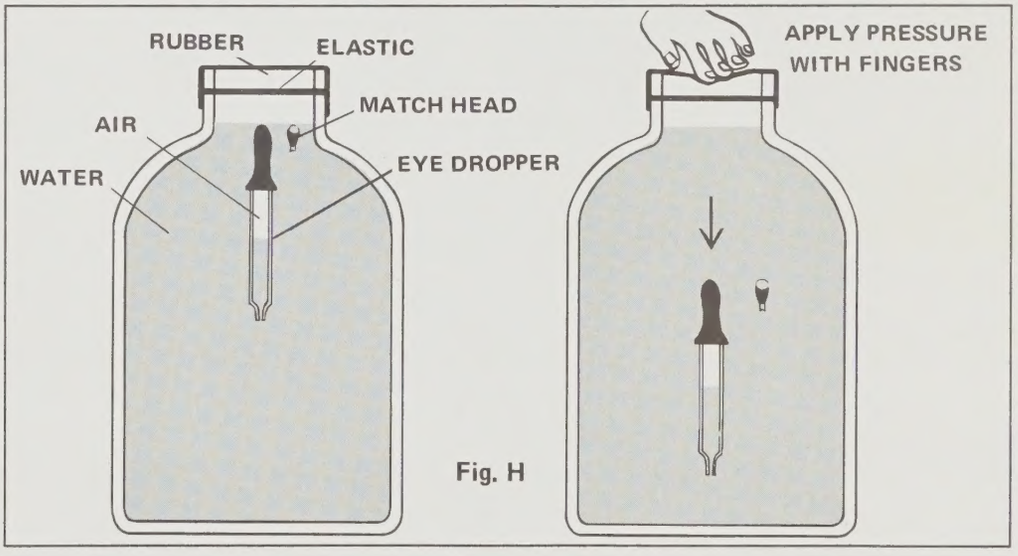

Fig. H

Heat Conduction

Set up a series of objects in the classroom which appear to range in feeling from cold to warm. Check each one with a thermometer to ensure that they are all the same temperature.

Magnetism

If work has already been done with magnets, you might still recreate the experiments seen in the program. Another experiment not shown on the program can be conducted easily by the students. Bring a reasonably strong magnet close to the screen of a television receiver. Rotate it slowly in a clockwise motion. What happens? The force of the magnet will bend the electrons which constitute the television picture. Do not try this experiment with a colour receiver as some damage may result.

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SWEZEY, KENNETH. *Science Tricks for Fun.* Fawcett Publications, 1952.

Scheduling for this series can be found in the monthly ETVO SCHEDULE sent to all teachers. For long-term planning, reference can be made to the ETV Schedule (Calendar), which lists programming from October to June and was mailed to all teachers. However, it is most important to check the monthly ETVO SCHEDULE for the last minute changes always involved in extensive programming.

JUNIOR MUSEUM